PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
M/44244-PCT		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/EP 03/09554	28/08/2003	28/08/2002
Applicant		
NUVERA FUEL CELLS EUROPE S.R.L.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 4 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language,** the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

[ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

[ ] contained in the international application in written form.

[ ] filed together with the international application in computer readable form.

[ ] furnished subsequently to this Authority in written form.

[ ] furnished subsequently to this Authority in computer readble form.

[ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

[ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

[X] the text is approved as submitted by the applicant.

[ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

[X] the text is approved as submitted by the applicant.

[ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 3

[X] as suggested by the applicant.

[ ] because the applicant failed to suggest a figure.

[ ] because this figure better characterizes the invention.

[ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 03/09554

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01M8/02 H01M8/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 810 795 A (TECHNICATOME SOC TECH POUR L E) 28 December 2001 (2001-12-28) the whole document	1,2,4,7, 8,10-12, 15-20, 23,24,28
P,X	EP 1 284 512 A (ASIA PACIFIC FUEL CELL TECHNOL) 19 February 2003 (2003-02-19) the whole document	1-4,10, 11,19, 20,28
P,X	WO 02 093669 A (BARNETT CHRISTOPHER JAMES ;GASCOYNE JOHN MALCOLM (GB); HARDS GRAHA) 21 November 2002 (2002-11-21) the whole document	1-4, 10-12, 15,16, 19,20, 23,24, 26,28

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 November 2003	26/11/2003

Name and mailing address of the ISA	Authorized officer
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Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
P[redacted]EP 03/09554

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 858 567 A (MUEGGENBERG H HARRY ET AL) 12 January 1999 (1999-01-12) the whole document ---	1,10,11, 15,17, 19,20, 23,24, 26,28
X	US 4 678 724 A (MCELROY JAMES F) 7 July 1987 (1987-07-07) the whole document ---	1,2, 10-12, 15,16, 19,20, 23,24, 26,28
X	US 4 737 257 A (BOULTON THOMAS) 12 April 1988 (1988-04-12) the whole document -----	1-4, 10-12, 15-17, 19,20, 23,24, 26,28

3

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 03/09554

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MEMBRANE ELECTROCHEMICAL GENERATOR

The present invention relates to a membrane electrochemical generator characterised by reduced weight, improved electrical insulation to the external environment and simplified assemblage. Processes of conversion of chemical to electric energy based on membrane electrochemical generators are known in the art. One example of prior art membrane electrochemical generator is outlined in figure 1. The electrochemical generator (1) is formed by a multiplicity of reaction cells (2) mutually connected in series and assembled according to a filter-press configuration. Each reaction cell (2) converts the free energy of reaction of a first gaseous reactant (fuel) with a second gaseous reactant (oxidant) without degrading it completely to thermal energy, thereby without being subject to the limitations of Carnot's cycle. The fuel is supplied to the anode compartment of the reaction cell (2) and consists for example of a mixture containing hydrogen or light alcohols, such as methanol or ethanol, while the oxidant is supplied to the corresponding cathode compartment and consists for instance of air or oxygen. The fuel is oxidised in the anode compartment simultaneously releasing H^+ ions, while the oxidant is reduced in the cathode compartment, consuming H^+ ions. An ion-exchange membrane separating the anode from the cathode compartment allows the continuous flow of H^+ ions from the anode to the cathode compartment while hindering the passage of electrons. The difference in the electric potential established at the poles of the reaction cell (2) is thereby maximised.

More in detail, each reaction cell (2) is delimited by a pair of electrically conductive flat -face bipolar sheets (3) enclosing, proceeding outwards, the ion-exchange membrane (4); a pair of porous electrodes (5); a pair of current collectors/distributors (7) realised by means of a reticulated conductive element of the type disclosed in US 5,482,792, electrically connecting the bipolar sheets (3) to the porous electrodes (5)

while simultaneously distributing the gaseous reactants; a pair of sealing gaskets (8) directed to seal the periphery of the reaction cell (2) to prevent the leakage of the gaseous reactants towards the external environment. In the bipolar sheets (3) and in the sealing gaskets (8) of each reaction cell (2), feed openings and discharge openings are present, not shown in figure 1, in communication with the cell anode and cathode chamber through distributing channels, also not shown in figure 1. The distributing channels are preferably obtained within the thickness of the sealing gaskets (8) and have a comb-like structure. They distribute and collect the gaseous reactants and the reaction products, the latter optionally mixed with the exhausts, in a uniform fashion within each reaction cell (2). The bipolar sheets (3) and the sealing gaskets (8) are also provided with openings for feeding and discharging a cooling fluid (typically deionised water) with the purpose of maintaining the electrochemical generator (1) at the required operating temperature. In a filter-press configuration, the coupling between the aforementioned openings determines the formation of two longitudinal manifolds directed to feed the gaseous reactants, two longitudinal manifolds directed to discharge the reaction products optionally mixed with exhausts and finally of coolant feed and discharge manifolds. Externally to the cell reaction (2) assembly, two terminal plates (11) are present, delimiting the electrochemical generator (1) and allowing, in co-operation with other devices such as springs or tie-rods, to keep the various components under compression ensuring thereby the gas sealing to the external environment and the longitudinal electric continuity. One of the two terminal plates (11) is provided with nozzles, not shown in figure 1, for connecting the aforementioned longitudinal manifolds to the external circuits. Moreover, both of the terminal plates (11) are provided with suitable holes (also not shown in figure 1) for housing the tie-rods by means of which the electrochemical generator (1) is tightened. As shown in figure 2, the electrochemical generator (1) of

the prior art may also comprise a multiplicity of cooling cells (20) interposed between the reaction cells (2). The cooling cells (20) are similar to the reaction cells (2) except they do not enclose the electrochemical package composed by the ion-exchange membrane (4), the porous electrodes (5) and the catalytic layers (6). The cooling cells (20), deputed to coolant flowing, contain a conductive element equivalent to the above disclosed collectors (7) and directed in this case to establish the electric continuity between two adjacent bipolar sheets while increasing the thermal exchange coefficient.

The electrochemical generator (1) of the prior art, although advantageous under several aspects, nevertheless is affected by a few drawbacks. Firstly, in order to decrease the costs and avoid problems of fragility, the electrochemical generator (1) is preferably assembled with metal bipolar sheets, for instance made of stainless steel, rather than of graphite or the known polymer-graphite composites. This leads however to a remarkable weight and complexity, since the generator comprises a high number of components. The use of a high number of components also entails a significant amount of seals, and thus a higher risk of leakages besides a difficult assemblage, be it manual or automated, with high execution times and subject to inexactness which may have consequences on its correct functioning. Other disadvantages associated to the structure of the above described electrochemical generator are given by the lack of electrical insulation to the external environment, by the contact of metal with fluids, particularly referred to the coolant, taking place within the longitudinal manifolds and giving rise to possible shunt currents, and finally by the dispersion of the thermal power produced by the generator to the external environment.

It is an object of the present invention to provide a membrane electrochemical generator comprising metal bipolar sheets, overcoming the drawbacks of the prior art.

For a better understanding of the present invention, some embodiments thereof are described hereafter, as mere non limiting examples and making reference to the attached drawings, wherein:

- figure 1 shows an exploded side-view of a first embodiment of a membrane electrochemical generator according to the prior art;
- figure 2 shows an exploded side-view of a second embodiment of the membrane electrochemical generator of figure 1;
- figure 3 shows an exploded side-view of an embodiment of a membrane electrochemical generator according to the invention;
- figure 4 shows a front-view of a component of the electrochemical generator of figure 3;
- figure 5a shows a view along section A-A of the component of figure 4;
- figure 5b shows a view taken along section B-B of the component of figure 4;
- figure 6 shows a front-view of a further embodiment of a component of the membrane electrochemical generator of figure 3;
- figure 7 shows a view along section C-C of the component of figure 6;
- figure 8 shows a view along section D-D of the component of figure 7;
- figure 9 shows a view along section C-C of an alternative embodiment of the component of figure 6;
- figure 10 shows a view along section E-E of the component of figure 9;
- figure 11 shows a front-view of a further embodiment of a component of the membrane electrochemical generator of figure 3;

- figure 12 represents a section of the component of figure 11 along section F-F; and
- figure 13 shows a view along section G-G of the component of figure 12.

Figure 3 shows an embodiment of electrochemical generator (100) in accordance with the invention formed by a multiplicity of reaction cells (101) mutually connected in series and assembled in a filter-press configuration, with cooling cells (120) intercalated thereto, equivalent to the above discussed cooling cells (20) of figure 2, in a 1:1 ratio to the reaction cells. In other embodiments such ratio may be different, such as 1:2 or 1:3. Each reaction cell (101) is delimited by a pair of flat-face bipolar sheets (102), among which are comprised, proceeding outwards, an ion-exchange membrane (103); a pair of porous electrodes (104); a pair of catalytic layers (105) deposited at the interface between the membrane (103) and each of the porous electrodes (104); a pair of current collectors/distributors (106), realised by means of a reticulated metallic element of the type disclosed in US 5,482,792, electrically connecting the bipolar sheets (102) to the porous electrodes (104) while simultaneously distributing the gaseous reactants.

As shown more in detail in figures 4, 5a, 5b, the bipolar sheets (102) are formed by a central metallic body (110), with dimensions slightly exceeding those of the active area of the reaction cells (101), integrated in a frame (111) made of polymeric material (for instance of thermoplastic or thermosetting type). The frame (111) is laid on the central metallic body (110) by moulding or gluing, optionally of separate pieces. The frame (111) advantageously takes care of all the functions of the sealing gasket (8) of the electrochemical generator of the prior art, which may therefore be omitted.

As shown in figure 4, the frame (111) presents first and second openings ($111a_1$, $111a_2$) for the passage of the gaseous reactants, respectively fuel and oxidant, first

and second openings ($111b_1$, $111b_2$) for the discharge of the reaction products optionally mixed with exhausts, openings (112) for feeding and discharging a cooling fluid. The frame (11) is also provided with a multiplicity of holes (150) for housing tie-rods by means of which the electrochemical generator (100) is tightened.

Furthermore, the frame (111) presents distributing channels (113a, 113b) (figure 5a) and cooling channels (114) (figure 5b), all obtained within the thickness of the frame itself. The distributing channels (113a) and (113b) are positioned at the interface with the central metallic body (110) and put the first and second openings ($111a_1$, $111a_2$) (only one of which is shown in figure 5a) and, respectively, the first and second openings ($111b_1$, $111b_2$) (only one of which is shown in figure 5a) in direct communication with the interior of the reaction cell (101) while the cooling channels (114) put the openings (112) in communication with the interior of the cooling cell (120). In a filter-press configuration, the coupling between openings ($111a_1$, $111a_2$) and openings ($111b_1$, $111b_2$) of all the frames (111) determines respectively the formation of two longitudinal manifolds (115) and two longitudinal manifolds (116), while the coupling between the openings (112) of all the frames (111) also determines the formation of relevant manifold, although they are not shown in figure 3 for the sake of simplicity. The two longitudinal manifolds (115), only one of which is shown in figure 3, are directed to feeding the gaseous reactants, the two longitudinal manifolds (116), only one of which is shown in figure 3, are directed to withdrawing the reaction products (water) optionally mixed with exhausts (gaseous inerts and unconverted fraction of reactants), the manifolds formed by the coupling of openings (112) are directed to feeding and extracting the cooling fluid.

Externally to the assembly of reaction cells (101), two terminal plates (117) are present (figure 3), delimiting the electrochemical generator (100). One of the two terminal plates (117) is provided with nozzles, not shown in figure 3, for the hydraulic

connection of the various longitudinal manifolds to the external circuits. Moreover, both of the terminal plates (117) are provided with appropriate holes (also not shown in figure 3) for housing the tie-rods.

In case the cooling cells (120) are interposed in a 1:1 ratio to the reaction cells (101), as shown in the embodiment of figure 3, the central metallic body (110) of the bipolar sheets (192) may be provided with a multiplicity of calibrated holes (130a, 130b) with diameter comprised between 0.1 and 5 mm, as shown in figure 6. Through the multiplicity of calibrated holes (130a) and (130b), respectively, the gaseous reactants flow into the reaction cell (101) and the reaction products and exhausts are withdrawn from the same, as will be illustrated more in detail hereafter. In a construction alternative, the calibrated holes (130a) and (130b) have regularly varied diameters with the purpose of ensuring an equal distribution of gaseous reactants and withdrawal of products. The holes (130a) and (130b) are respectively positioned below and above the inner edges of frame (111) on the side opposite to that containing the distributing channels (131) and (132). The distance of the holes from the edges of frame (111) is preferably about 1 mm for a better exploitation of the reaction cell (101) active area.

Making now reference to figure 7, representing a side-view of the bipolar sheet of figure 6 along section C-C, the frame (111) presents, on the side opposite to cooling cell (120), a distributing zone of gaseous reactants (131) in communication with first and second openings ($111a_1$, $111a_2$), and a collection zone of the reaction products and exhausts (132) in communication with first and second openings ($111b_1$, $111b_2$). The distributing zone of gaseous reactants (131) and the collection zone of the reaction products and exhausts (132) are both obtained within the thickness of the frame (111). On the side opposite to the reaction cell (101), the frame (111) is free of channels and its thickness on this side may be optimised as a function of the

thickness of the membrane-electrode-collector assembly without further constraints. The distributing (131) and collection (132) zones are shown in figure 8, representing a front-view of the section of bipolar sheet (102) of figure 7 along the D-D plane. Channels (133) and (134) coincide with the alignment of holes (130a) and (130b).

In this case, the electrochemical generator (100) operates as follows: the gaseous reactants (fuel and oxidant), which are supplied to the electrochemical generator (100) through the longitudinal manifolds (115), flow to the distributing zone (131). from here, the gaseous reactants flow across the channel (133) and through the multiplicity of calibrated holes (130a), and are injected into the reaction cell (101). The reaction products and exhausts produced therein pass in their turn through the multiplicity of calibrated holes (130b) and across the channel (134) reaching the collection zones (132) and the manifolds (116) through which they exit the electrochemical generator (100).

In an alternative embodiment, the holes (130a) are used for injecting water directly into the reaction cell instead than for the injection of the gaseous reactants as seen above. In this case, the injected water plays a double role, namely providing for the humidification of the gases and the membrane (103) and for the withdrawal of the heat of reaction upon partially evaporating. The unevaporated water is extracted from the reaction cell together with the products and exhausts through the collection zone in communication with a longitudinal discharge manifold. The holes (130b) can therefore be eliminated. By virtue of the cooling effect produced by the water directly injected into the reaction cell, the supply of coolant, for instance water, to the cooling cells (120) is no more required. The cells (120), although maintaining the structure of figure 3 comprising the element (106), retain the sole function of establishing the electric contact between the metallic bodies (110) of two adjacent bipolar sheets (102). Taking figure 6 as reference, the section along the line C-C is represented, as

regards this specific case, in figure 9, wherein the common parts with the previous figures are indicated with the same reference numbers. For the sake of better understanding, the section of the bipolar sheet of figure 9 along the line E-E is represented in figure 10, wherein the development of the channel (135) coinciding with holes (130a) and permitting the injection of water coming from (112) through the same is evidenced. The supply of reactant gases and the withdrawal of products and exhausts takes place, as indicated in figure 5a, through the channels (113a) and (113b). In this case, the thickness of the gasket (111) on the reaction cell side, similarly to the case of the embodiment of figure 5a, is limited by the necessity of housing the channels (113a) and (113b) and cannot be freely optimised as allowed by the embodiment of figure 7. It is possible to enjoy such advantage again, simultaneously making use of the effective direct water injection, by means of a further embodiment of the invention, characterised by resorting to a frame design encompassing the two concepts of gas distribution and water injection outlined in figures 7 and 9. Such embodiment is represented in figure 11 as a front-view of bipolar sheet (102) wherein the common parts with the previous figures are indicated with the same reference numbers. As it can be seen, the central metallic body (110) is provided with a double row of holes, respectively 130a for feeding the gaseous reactants and (136) for injecting water, and with a single row of holes 130b directed to the withdrawal of reaction products, exhausts and residual water. For the sake of a better understanding, the section of the frame (111) along the line F-F is represented in figure 12 showing the section of the distributing channel (135) of the water to be injected into the reaction cell (101) through the holes (136). A front-view of a further section of the bipolar sheet along the line G-G of figure 12 is shown in figure 13.

The advantages obtained with the above disclosed invention are the following:

a) reduction in weight of the electrochemical generator according to the invention: the electrochemical generator made in accordance with the present invention provides the use of bipolar sheets with a metallic portion having dimensions slightly superior to those of the reaction cell active area, while the metallic bipolar sheets of the prior art have dimensions substantially coinciding with the whole front area of the generator; the esteemed weight reduction due to this modification is about 30%.

b) reduction in the number of components making up the electrochemical generator according to the invention: the reduction in the number of components entails a remarkable advantage in terms of reduction of the time for the assemblage and of the relevant costs, besides decreasing the occurrence of errors. For instance, the assemblage of a generator according to the prior art of figure 2 comprising n reaction cells requires 3 x n gaskets and 2 x n bipolar plates for a total of 5 x n components (without considering the components relative to the electrochemical package, which remain unvaried); making use of the electrochemical generator (100) of the invention according to the embodiment of figure 3, only 2 x n components are required.

c) reduction in the number of seals: ensuring a leak-free sealing in the assemblage of a multiplicity of parts made of diverse materials is one of the main problems to be faced during the construction of generators, and such problems is not always of straightforward resolution. The assemblage of the prior art generator of figure 2 with n reaction cells entails 5 x n sealed surfaces, reduced to 2 x n when bipolar sheets in accordance with the invention are employed.

d) better alignment and centring of the components: the bipolar sheets in accordance with the invention allow to improve the component alignment

during the assemblage of the generator since, as mentioned above, the amount of components is much reduced and the polymer frames are automatically in the right position, contrarily to what happens with the prior art technology, wherein the components to assemble are many and the positioning of the gaskets, which are not secured to the bipolar sheets, is undoubtedly difficult. Also the centring of the other elements of the electrochemical generator (current collector/distributor, electrodes and membrane) is made simpler by the presence of a predisposed seat delimited by the frame (111).

e) improved external electrical insulation: the bipolar sheets according to the invention allow to electrically insulating the generator from the external environment while reducing the dispersion of thermal power.

f) absence of fluid to metal contacts in the feed and discharge manifolds: another relevant issue when metallic components are used within electrochemical generators is trying to reduce at most the contact of metals with fluids (humidified gaseous reactants, coolant) so as to reduce the risks of corrosion and to suppress the shunt currents. The use of the bipolar sheets according to the invention allows eliminating the metallic parts both from the feed and discharge manifolds of the humidified gaseous reactants and from the feed and discharge manifolds of the coolant since all these ducts are obtained within the polymer frame.

The production of the bipolar sheets of the invention consisting of a central metallic body optionally provided with holes for distribution and collection and integrated with a frame of plastic material incorporating the different openings and channels may be achieved with one of the methods listed hereafter:

- application of leachable elements shaped as the sections of the various channels to the metallic body, moulding of the plastic material in order to form the integral frame and leaching with a suitable reactant after optional cooling in the case of thermoplastic materials or after completion of polymerisation in the case of thermosetting materials. An adequate leachable material is aluminium, which is easily dissolved with caustic soda. The plastic material of the frame must have mechanical characteristics, in particular minimum long-term deformability at the operative temperature and under the typical operative compression conditions, suitable for maintaining the passage section of the various channels substantially unvaried.
- application of preformed element having the shape of the required channels on the metallic body followed by moulding of the plastic material so as to form the integral frame. the preformed materials may be made of metal, preferably stainless steel, or plastics: if the mechanical resilience to compression of the preformed elements is high, the above constraints of low deformability for the frame material are overcome.
- pre-forming of the frames, e.g. by moulding, optionally in two sections, each consisting of a face of said frame and comprising its own channels, and assemblage with the metallic body by thermal bonding or preferably by gluing with suitable adhesive, in order to prevent any damage to the section of passage of the channels. The selection of the frame material is in this case subjected, besides the constraints of minimum deformability, also to those of compatibility with the commercial adhesives, among which the thin film adhesives are preferred.

To improve the adhesion between metallic body and frame material, with an adhesive optionally interposed, the metallic body is preferably subjected to pre-

treatments such as fine sandblasting and/or chemical attacks, with the aim of producing a micro-rough and chemically reactive surface. A further measure, equally directed to impart adhesion between metallic body and frame, may consist of providing the metallic body with openings in the peripheral zone, wherein the frame material may penetrate during the moulding step thereby establishing a continuity between the two faces of the frame itself.

The above description shall not be understood as limiting the invention, which may be practised according to different embodiments without departing from the scopes thereof, and whose extent is solely defined by the appended claims.

In the description and claims of the present application, the word "comprise" and its variation such as "comprising" and "comprises" are not intended to exclude the presence of other elements or additional components.

CLAIMS

1. Membrane electrochemical generator fed with gaseous reactants and comprising a multiplicity of reaction cells assembled in a filter-press configuration, each of said reaction cells being delimited by bipolar sheets, characterised in that said bipolar sheets are formed by a metallic central body integrated in a frame made of polymeric material and containing distributing and collecting channels.

2. Generator according to claim 1, characterised in that said polymeric material is of the thermoplastic type.

3. Generator according to claim 1, characterised in that said polymeric material is of the thermosetting type.

4. Generator according to anyone of the preceding claims, characterised in that said frame is integrated with said central metallic body by moulding.

5. Generator according to claim 4 characterised in that said metallic central body is previously provided with leachable elements having the shape of said distributing and collecting channels and that said leachable elements are dissolved with a reactant after said moulding.

6. Generator according to claim 5 characterised in that said leachable elements are made of aluminium and said reactant is caustic soda.

7. Generator according to claim 4 characterised in that said metallic central body is previously provided with preformed elements having the shape of said distributing and collecting channels.

8. Generator according to claim 7 characterised in that said preformed elements are made of metal or plastics

9. Generator according to claim 8 characterised in that said metal is stainless steel

10. Generator according to anyone of claims 1 to 3 characterised in that said frame integrated with said metallic central body consists of two preformed components containing said distributing and collecting channels.

11. Generator according to claim 10 characterised in that each of said two preformed components constitutes a face of said frame.

12. Generator according to anyone of claims 10 or 11 characterised in that said two components are assembled with each other and with said metallic central body by thermal bonding or gluing with an adhesive.

13. Generator according to anyone of claims 4 or 12 characterised in that said metallic central body has a micro-rough and/or chemically reactive surface obtained by sandblasting and/or chemical attack.

14. Generator according to claim 4 characterised in that said metallic central body is provided with openings in the peripheral zone suited to favour the adhesion of said moulded frame.

15. Generator according to anyone of the preceding claims, characterised in that said frame comprises first and second feed openings for the passage of said gaseous reactants, first and second discharge openings for the withdrawal of said reaction products optionally mixed with exhausts, openings for feeding and extracting a coolant, said openings being in communication with said distributing and collecting channels.

16. Generator according to claim 15, characterised in that in a filter-press configuration the coupling between said openings of said frames determines the formation of longitudinal feed manifolds, the coupling between said discharge openings determines the formation of longitudinal discharge manifolds, the coupling between said openings for feeding and extracting a coolant determines the formation of manifolds for circulating said coolant.

17. Generator according to claim 15 characterised in that said frame further comprises a multiplicity of holes for housing tie-rods by means of which the tightening of said electrochemical generator is accomplished.

18. Generator according to anyone of the preceding claims, characterised in that it comprises a multiplicity of cooling cells interposed between said reaction cells, each cooling cell being delimited by a pair of said bipolar sheets.

19. Generator according to anyone of the preceding claims, characterised in that said metallic central body comprises a multiplicity of first calibrated holes for the passage of said gaseous reactants and a multiplicity of second calibrated holes for the discharge of reaction products and optionally exhausts.

20. Generator according to claim 19 characterised in that said first calibrated holes are mutually aligned and positioned in correspondence of said distributing channels of said frame and that said second calibrated holes mutually aligned and positioned in correspondence of said collecting channels of said frame.

21. Generator according to anyone of claims 19 or 20 characterised in that said first and second calibrated holes are spaced by about 1 mm from the inner edge of said frame.

22. Generator according to anyone of claims 19-21 characterised in that said first calibrated holes have a diameter comprised between 0.1 and 5 mm.

23. Generator according to anyone of claims 1-18 characterised in that said metallic central body comprises a multiplicity of aligned calibrated holes for injecting water into said reaction cells.

24. Generator according to claim 23 characterised in that said aligned calibrated holes are positioned in correspondence of additional water distributing channels.

25. Generator according to claim 23 characterised in that said aligned calibrated holes are spaced by about 1 mm from the inner edge of said frame.

26. Generator according to anyone of claims 1-18 characterised in that said central body comprises a multiplicity of aligned calibrated holes for distributing the gaseous reactants, a multiplicity of aligned calibrated holes for injecting water and a multiplicity of aligned calibrated holes for withdrawing the products, the exhausts and the residual injected water, each of said calibrated holes positioned in correspondence of one of said distributing or of said collecting channels.

27. Generator according to claim 26 characterised in that said aligned calibrated holes for distributing the gaseous reactants and said aligned calibrated holes for withdrawing the products, the exhausts and the residual injected water are spaced by about 1 mm from the inner edges of said frame.

28. Membrane electrochemical generator substantially as hereinbefore with reference to the attached drawings.

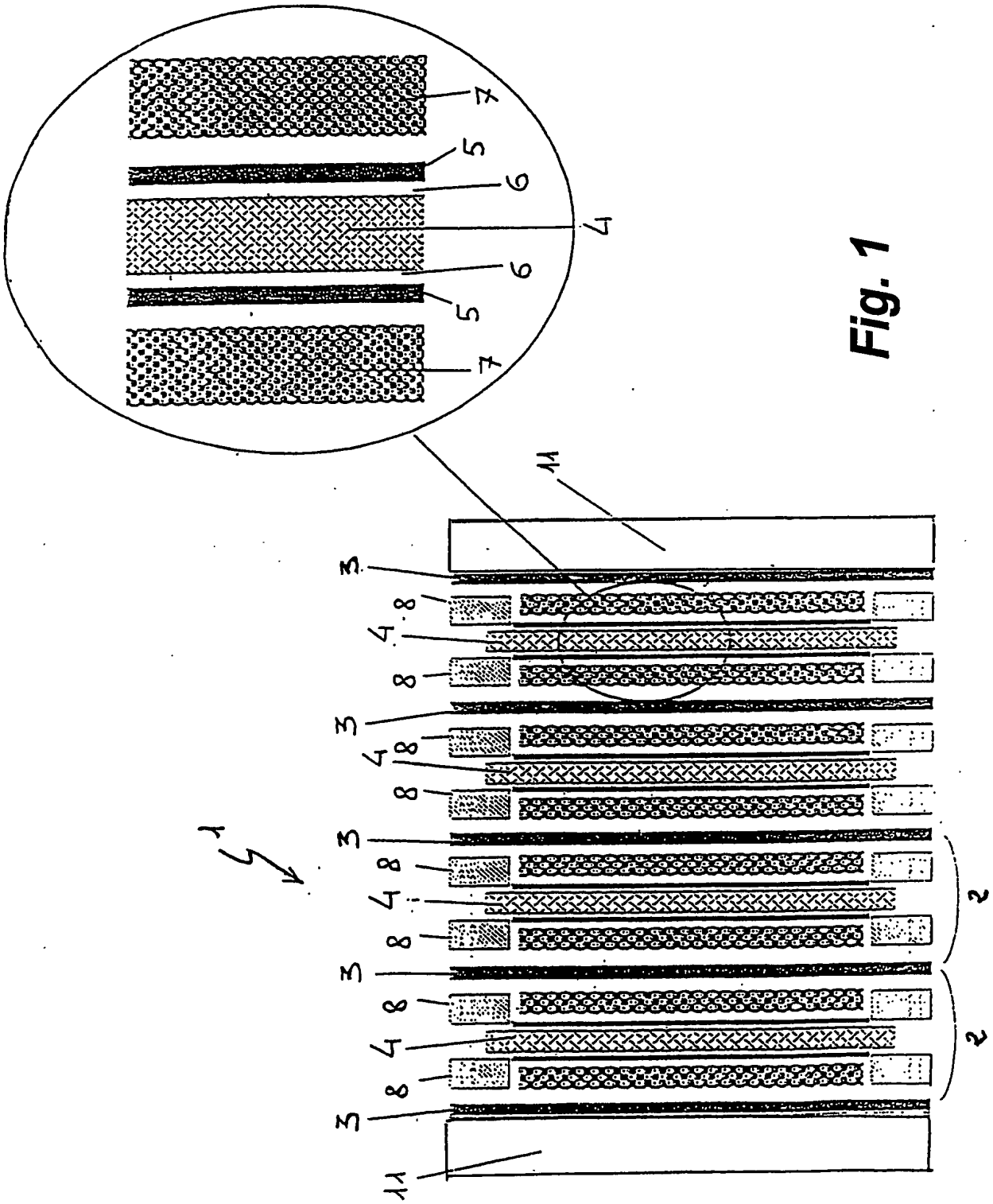

Fig. 1

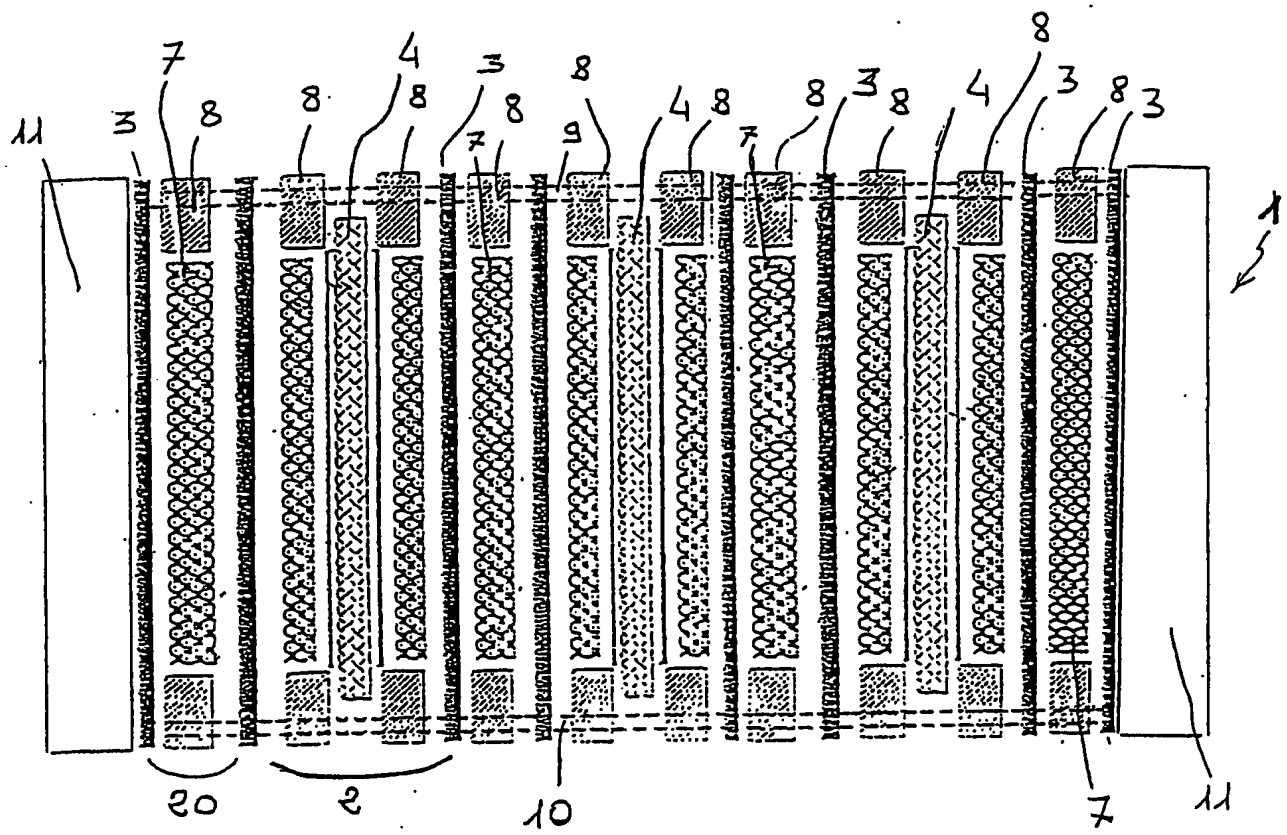

Fig. 2

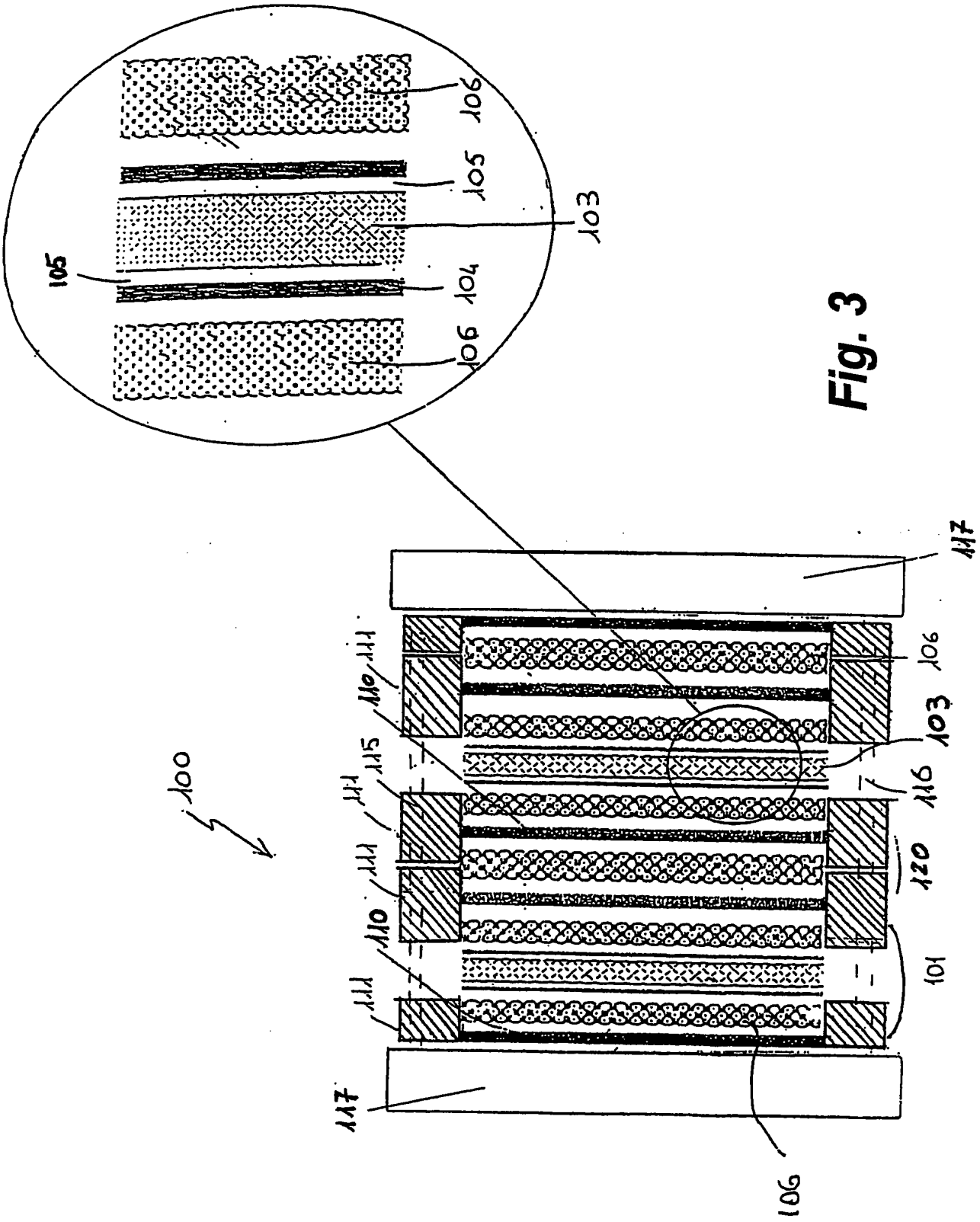
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Fig. 3

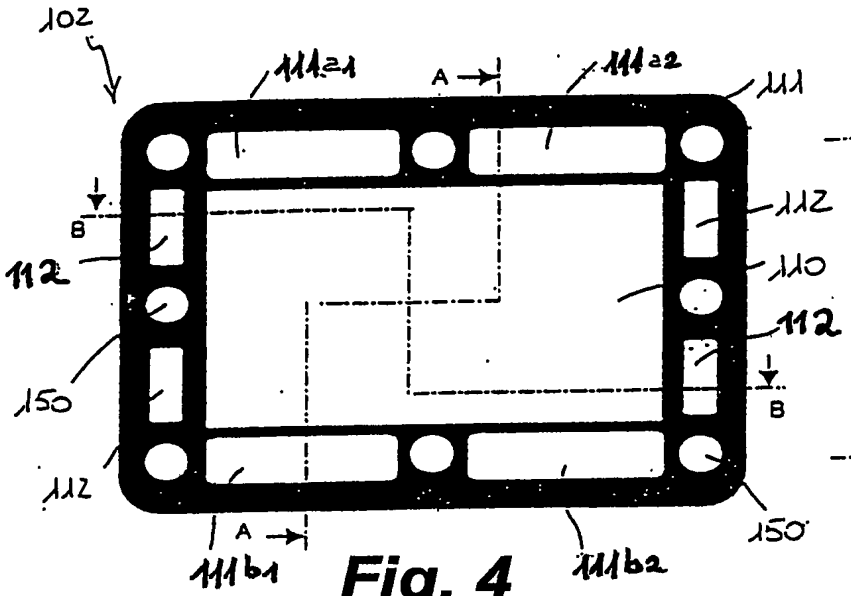

Fig. 4

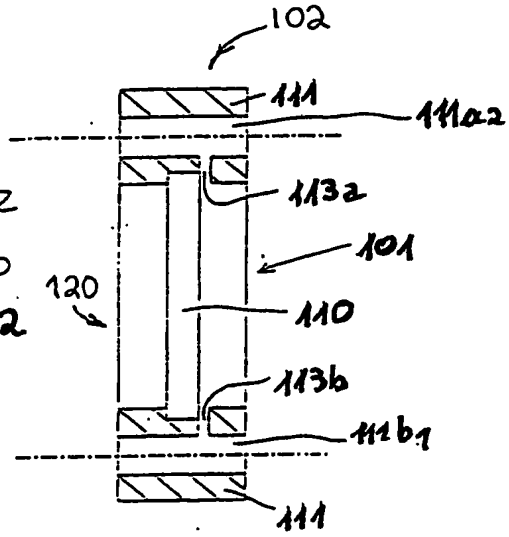

Fig. 5a

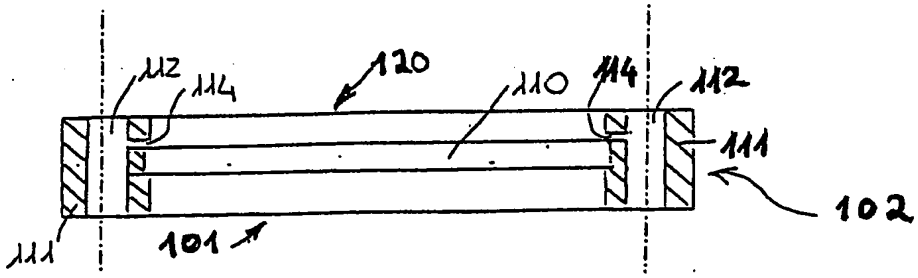

Fig. 5b

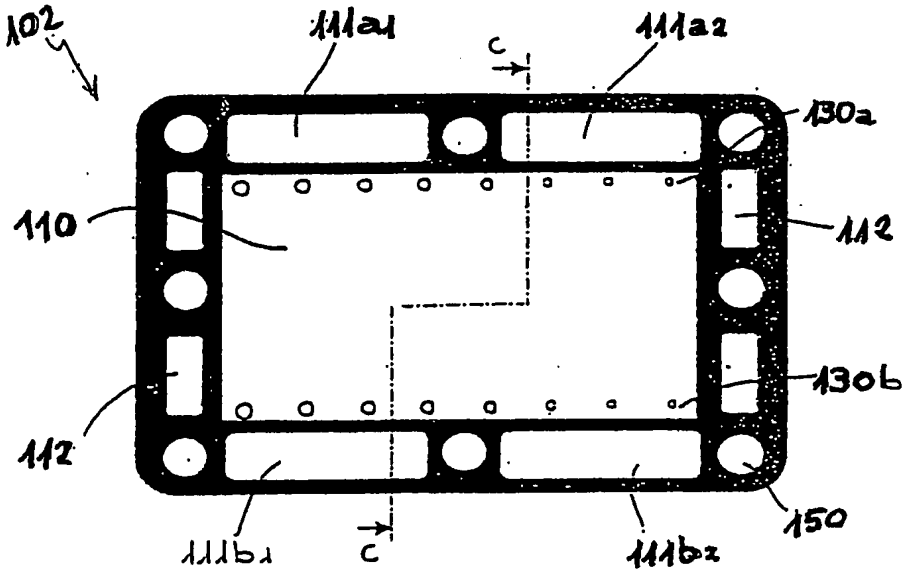

Fig. 6

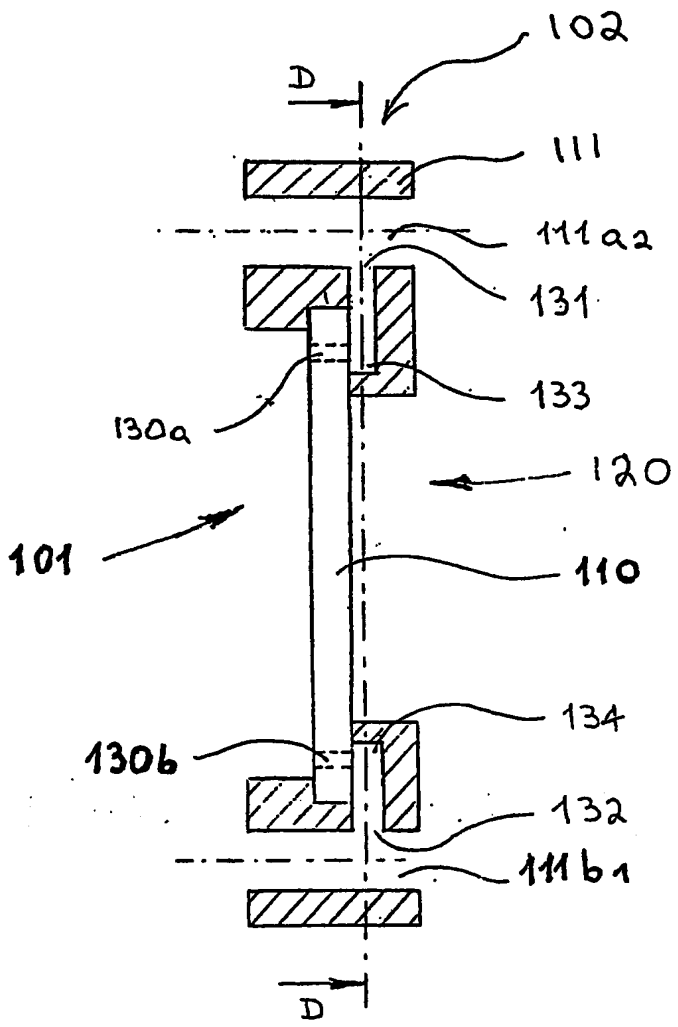
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Fig. 7

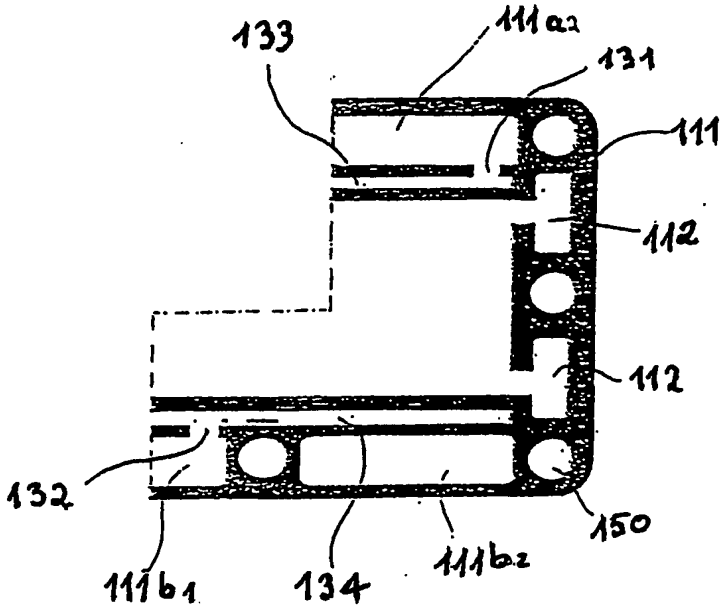
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Fig. 8

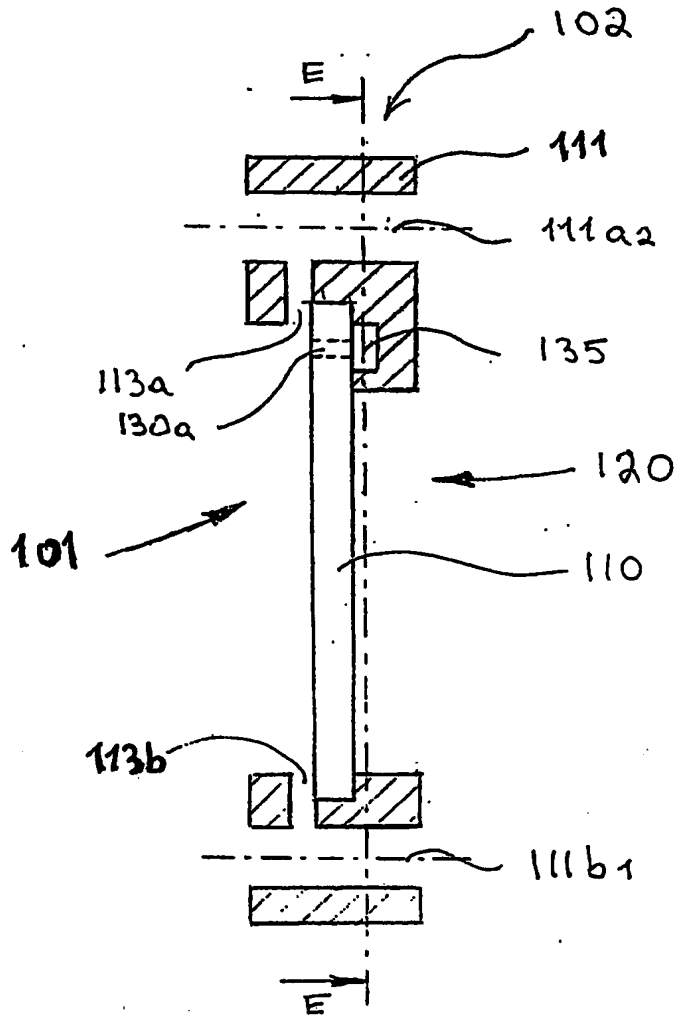
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Fig. 9

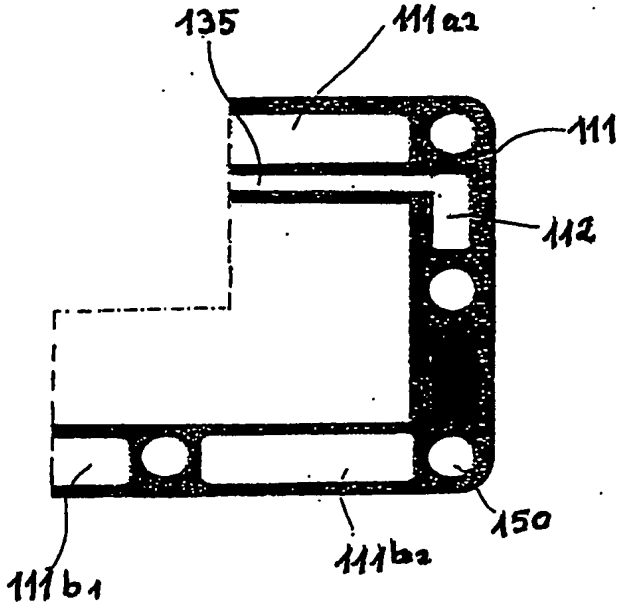
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Fig. 10

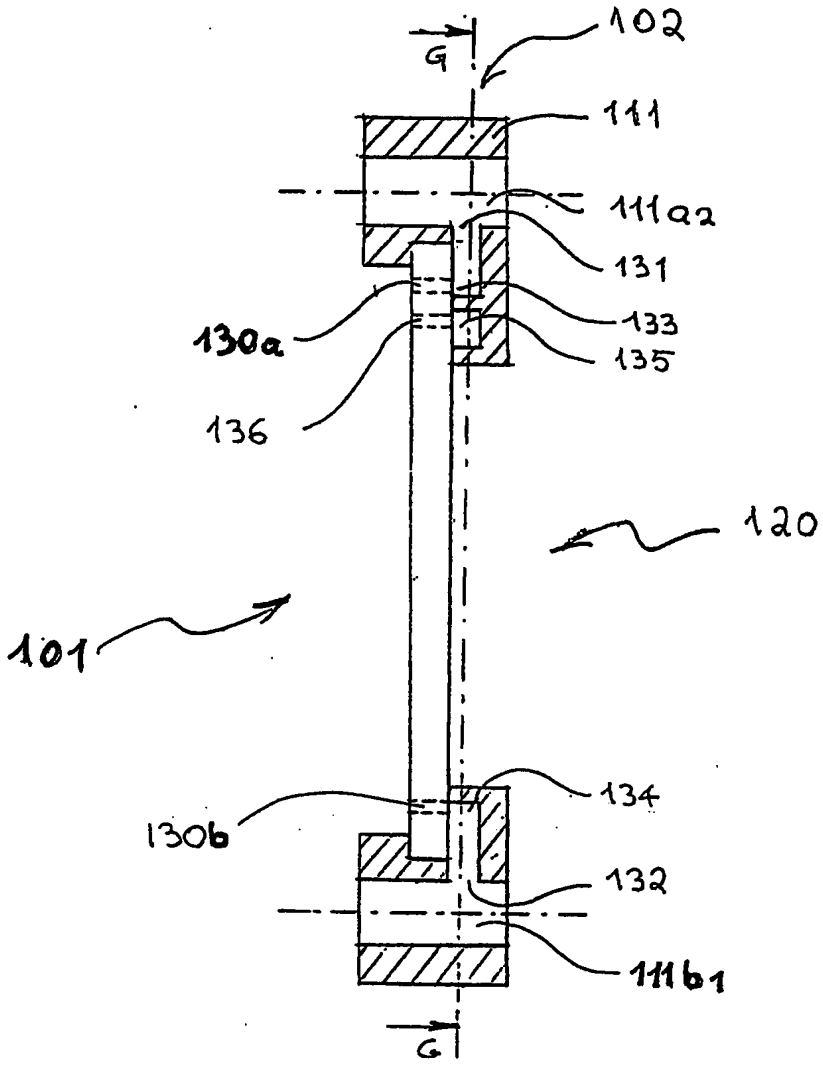

Fig. 12

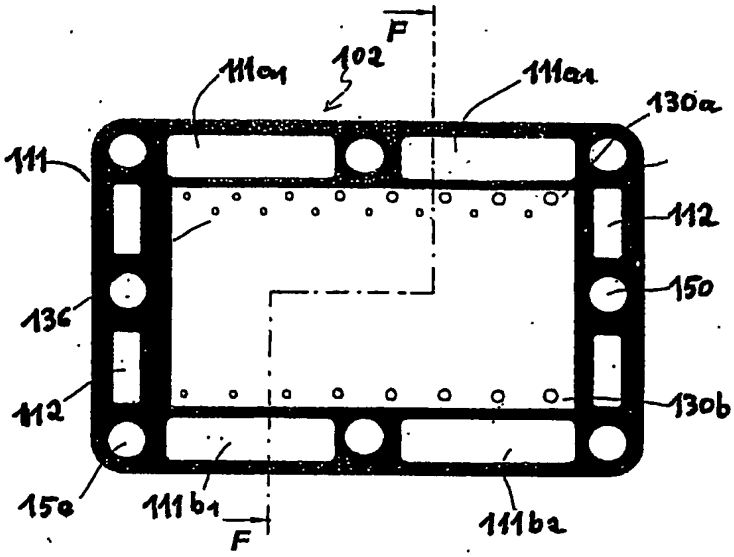

Fig. 11

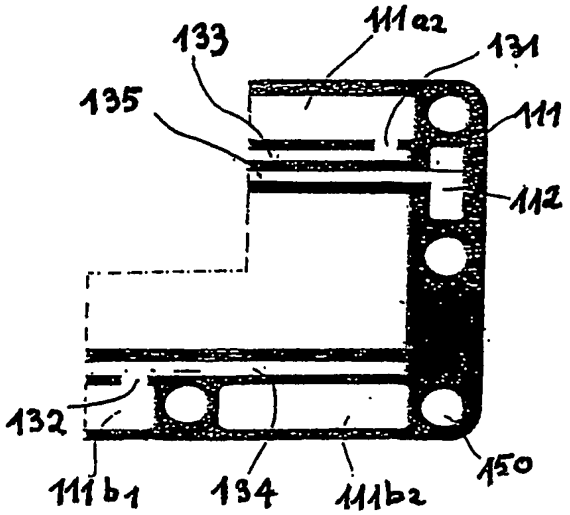

Fig. 13

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 03/09554

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01M8/02 H01M8/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 810 795 A (TECHNICATOME SOC TECH POUR L E) 28 December 2001 (2001-12-28) the whole document ---	1,2,4,7, 8,10-12, 15-20, 23,24,28
P,X	EP 1 284 512 A (ASIA PACIFIC FUEL CELL TECHNOL) 19 February 2003 (2003-02-19) the whole document ---	1-4,10, 11,19, 20,28
P,X	WO 02 093669 A (BARNETT CHRISTOPHER JAMES ;GASCOYNE JOHN MALCOLM (GB); HARDS GRAHA) 21 November 2002 (2002-11-21) the whole document --- -/--	1-4, 10-12, 15,16, 19,20, 23,24, 26,28

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 November 2003	26/11/2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Koessler, J-L

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 03/09554

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 858 567 A (MUEGGENBERG H HARRY ET AL) 12 January 1999 (1999-01-12) the whole document	1,10,11, 15,17, 19,20, 23,24, 26,28
X	US 4 678 724 A (MCELROY JAMES F) 7 July 1987 (1987-07-07) the whole document	1,2, 10-12, 15,16, 19,20, 23,24, 26,28
X	US 4 737 257 A (BOULTON THOMAS) 12 April 1988 (1988-04-12) the whole document	1-4, 10-12, 15-17, 19,20, 23,24, 26,28

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 03/09554

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		EP 1284512 A2	19-02-2003
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		EP 0783770 A1	16-07-1997
		JP 10507573 T	21-07-1998
		RU 2174728 C2	10-10-2001
		WO 9612316 A1	25-04-1996
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		JP 59031568 A	20-02-1984
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		AU 5605486 A	23-10-1986
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		CA 1281681 C	19-03-1991
		DE 3674236 D1	25-10-1990
		EP 0199493 A1	29-10-1986
		FI 861628 A ,B,	19-10-1986
		JP 62188789 A	18-08-1987
		NO 861510 A	20-10-1986
		ZA 8602584 A	26-11-1986

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
11 March 2004 (11.03.2004)

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(10) International Publication Number
WO 2004/021490 A1

(51) International Patent Classification[7]: H01M 8/02, 8/24

(21) International Application Number:
PCT/EP2003/009554

(22) International Filing Date: 28 August 2003 (28.08.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
MI2002A001859 28 August 2002 (28.08.2002) IT

(71) Applicant *(for all designated States except US)*: NUVERA FUEL CELLS EUROPE S.R.L [IT/IT]; Via Bistolfi, 35, I-20134 Milano (IT).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: TRIFONI, Eduardo [IT/IT]; Via Donizetti, 5, I-80127 Napoli (IT). LIOTTA, Marcello [IT/IT]; Via della Cooperazione 117, I-20089 Rozzano (IT).

(74) Agent: REITSTÖTTER, KINZEBACH & PARTNER (GbR); Sternwartstrasse 4, 81679 München (DE).

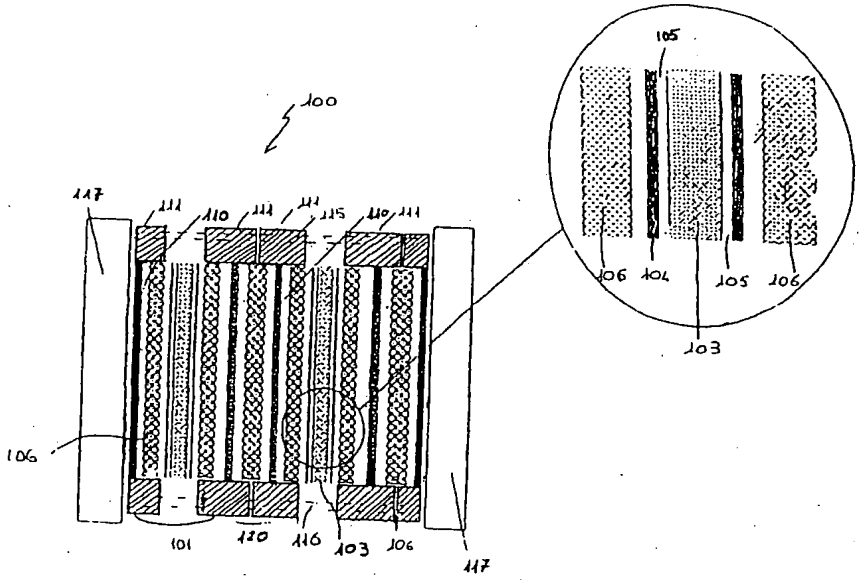
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: MEMBRANE ELECTROCHEMICAL GENERATOR



(57) Abstract: The present invention relates to a membrane electrochemical generator (100) characterised by improved electrical insulation and reduced volume. The membrane electrochemical generator (100) is fed with gaseous reactants and comprises a multiplicity of reaction cells (101) assembled in a filter-press configuration. Each of said reaction cells (101) is delimited by a pair of bipolar sheets (102), formed by a metallic central body (110) integrated in a frame (111) made of polymeric material. The polymeric material may be of the thermoplastic or thermosetting type and the frame (111) is laid on the metallic central body (110) by moulding.

WO 2004/021490 A1

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 03/09554

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01M8/02 H01M8/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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P,X	WO 02 093669 A (BARNETT CHRISTOPHER JAMES ;GASCOYNE JOHN MALCOLM (GB); HARDS GRAHA) 21 November 2002 (2002-11-21) the whole document	1-4, 10-12, 15,16, 19,20, 23,24, 26,28

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° Special categories of cited documents :

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"E" earlier document but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 November 2003	26/11/2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Koessler, J-L

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 03/09554

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	US 4 678 724 A (MCELROY JAMES F) 7 July 1987 (1987-07-07) the whole document	1,2, 10-12, 15,16, 19,20, 23,24, 26,28
X	US 4 737 257 A (BOULTON THOMAS) 12 April 1988 (1988-04-12) the whole document	1-4, 10-12, 15-17, 19,20, 23,24, 26,28

INTERNATIONAL SEARCH REPORT

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Inte[illegible]al Application No
PCT/EP 03/09554

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
FR 2810795	A	28-12-2001	FR	2810795 A1	28-12-2001
EP 1284512	A	19-02-2003	CN	1405910 A	26-03-2003
			EP	1284512 A2	19-02-2003
WO 02093669	A	21-11-2002	WO	02093669 A2	21-11-2002
US 5858567	A	12-01-1999	AU	4193996 A	06-05-1996
			CA	2202380 A1	25-04-1996
			EP	0783770 A1	16-07-1997
			JP	10507573 T	21-07-1998
			RU	2174728 C2	10-10-2001
			WO	9612316 A1	25-04-1996
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			JP	1741329 C	15-03-1993
			JP	4025673 B	01-05-1992
			JP	59031568 A	20-02-1984
			US	4649091 A	10-03-1987
US 4737257	A	12-04-1988	AU	578821 B2	03-11-1988
			AU	5605486 A	23-10-1986
			BR	8601734 A	23-12-1986
			CA	1281681 C	19-03-1991
			DE	3674236 D1	25-10-1990
			EP	0199493 A1	29-10-1986
			FI	861628 A ,B,	19-10-1986
			JP	62188789 A	18-08-1987
			NO	861510 A	20-10-1986
			ZA	8602584 A	26-11-1986

The demand must be filed directly with the competent International Preliminary Examining Authority; if two or more Authorities are competent, with the one chosen by the applicant. The full name or two-letter code of that Authority may be indicated by the applicant on the line below:

IPEA/_____

PCT

CHAPTER II

DEMAND

under Article 31 of the Patent Cooperation Treaty:
The undersigned requests that the international application specified below be the subject of international preliminary examination according to the Patent Cooperation Treaty.

For International Preliminary Examining Authority use only

Identification of IPEA	Date of receipt of DEMAND

Box No. I IDENTIFICATION OF THE INTERNATIONAL APPLICATION

Applicant's or agent's file reference: M/44244-PCT

International application No.	International filing date *(day/month/year)*	(Earliest) Priority date *(day/month/year)*
PCT/EP03/09554	28.08.2003	28.08.2002

Title of invention: Membrane electrochemical generator

Box No. II APPLICANT(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

Nuvera Fuel Cells Europe S.r.l.
Via Bistolfi, 35
I-20134 Milano
ITALY

Telephone No.

Facsimile No.

Teleprinter No.

Applicant's registration No. with the Office

State *(that is, country)* of nationality:	State *(that is, country)* of residence:
IT	IT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

Trifoni, Eduardo
Via Donizetti 5
80127 Napoli
ITALY

State *(that is, country)* of nationality:	State *(that is, country)* of residence:
IT	IT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

Liotta, Marcello
Via della Cooperazione 117
20089 Rozzano (MI)
ITALY

State *(that is, country)* of nationality:	State *(that is, country)* of residence:
IT	IT

☐ Further applicants are indicated on a continuation sheet.

International application No.
PCT/EP03/09554

Box No. III AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The following person is [X] agent [ ] common representative

and [X] has been appointed earlier and represents the applicant(s) also for international preliminary examination.

[ ] is hereby appointed and any earlier appointment of (an) agent(s)/common representative is hereby revoked.

[ ] is hereby appointed, specifically for the procedure before the International Preliminary Examining Authority, in addition to the agent(s)/common representative appointed earlier.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

Reitstötter • Kinzebach
Reitstötter, Kinzebach & Partner (GbR)
Patentanwälte
Postfach 86 06 49
D - 81633 München

Telephone No.
089-99 83 970

Facsimile No.
089-98 73 04

Teleprinter No.

Agent's registration No. with the Office
Z 217

[ ] **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Box No. IV BASIS FOR INTERNATIONAL PRELIMINARY EXAMINATION

Statement concerning amendments:*

1. The applicant wishes the international preliminary examination **to start on the basis of:**

[ ] the international application as originally filed

the description
[ ] as originally filed
[ ] as amended under Article 34

the claims
[ ] as originally filed
[ ] as amended under Article 19 (together with any accompanying statement)
[ ] as amended under Article 34

the drawings
[ ] as originally filed
[ ] as amended under Article 34

2. [ ] The applicant wishes any amendment to the claims under Article 19 to be considered as reversed.

3. [ ] The applicant wishes the start of the international preliminary examination **to be postponed** until the expiration of the applicable time limit under Rule 69.1(d).

4. [ ] The applicant expressly wishes the international preliminary examination **to start earlier** than at the expiration of the applicable time limit under Rule 54bis.1(a).

* Where no check-box is marked, international preliminary examination will start on the basis of the international application as originally filed or, where a copy of amendments to the claims under Article 19 and/or amendments of the international application under Article 34 are received by the International Preliminary Examining Authority before it has begun to draw up a written opinion or the international preliminary examination report, as so amended.

Language for the purposes of international preliminary examination: English

[X] which is the language in which the international application was filed.

[ ] which is the language of a translation furnished for the purposes of international search.

[ ] which is the language of publication of the international application.

[ ] which is the language of the translation (to be) furnished for the purposes of international preliminary examination.

Box No. V ELECTION OF STATES

The filing of this demand constitutes the election of all Contracting States which are designated and are bound by Chapter II of the PCT.

See Notes to the demand form

International application No.
PCT/EP03/09554

Box No. VI CHECK LIST

The demand is accompanied by the following elements, in the language referred to in Box No. IV, for the purposes of international preliminary examination:

			For International Preliminary Examining Authority use only: received	not received
1. translation of international application	:	sheets	☐	☐
2. amendments under Article 34	:	sheets	☐	☐
3. copy (or, where required, translation) of amendments under Article 19	:	sheets	☐	☐
4. copy (or, where required, translation) of statement under Article 19	:	sheets	☐	☐
5. letter	:	sheets	☐	☐
6. other *(specify)* :	:	sheets	☐	☐

The demand is also accompanied by the item(s) marked below:

1. ☒ fee calculation sheet
2. ☐ original separate power of attorney
3. ☐ original general power of attorney
4. ☐ copy of general power of attorney; reference number, if any:
5. ☐ statement explaining lack of signature
6. ☐ sequence listing in computer readable form
7. ☒ other *(specify)*:

Request for detailed substantive examination

Box No. VII SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the demand).

Munich, March 29, 2004

J. Uwe Müller

For International Preliminary Examining Authority use only

1. Date of actual receipt of DEMAND:

2. Adjusted date of receipt of demand due to CORRECTIONS under Rule 60.1(b):

3. ☐ The date of receipt of the demand is AFTER the expiration of 19 months from the priority date and item 4 or 5, below, does not apply.
   ☐ The applicant has been informed accordingly.
4. ☐ The date of receipt of the demand is WITHIN the time limit of 19 months from the priority date as extended by virtue of Rule 80.5.
5. ☐ Although the date of receipt of the demand is after the expiration of 19 months from the priority date, the delay in arrival is EXCUSED pursuant to Rule 82.
6. ☐ The date of receipt of the demand is AFTER the expiration of the time limit under Rule 54bis.1(a) and item 7 or 8, below, does not apply.
7. ☐ The date of receipt of the demand is WITHIN the time limit under Rule 54bis.1(a) as extended by virtue of Rule 80.5.
8. ☐ Although the date of receipt of the demand is after the expiration of the time limit under Rule 54bis.1(a), the delay in arrival is EXCUSED pursuant to Rule 82.

For International Bureau use only

Demand received from IPEA on:

Detailed preliminary examination is herewith requested. It is referred to the Official Communication issued by the President of the European Patent Office dated November 2, 2001 (Official Gazette No. 11/2001, pp 539 – 542, pt. 5).

Munich, 29.03.2004

J. Uwe Müller

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

Reitstötter, Kinzebach
& Partner (GbR)
Postfach 86 06 49
D-81633 München
ALLEMAGNE

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

Date of mailing *(day/month/year)*	05.10.2004
Applicant's or agent's file reference M/44244-PCT	**IMPORTANT NOTIFICATION**

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP 03/09554	28.08.2003	28.08.2002

Applicant
NUVERA FUEL CELLS EUROPE S.R.L. et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed inventions is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the international preliminary examining authority:	Authorized Officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Marchetto, L Tel. +49 89 2399-2796

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference M/44244-PCT	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/EP 03/09554	International filing date *(day/month/year)* 28.08.2003	Priority date *(day/month/year)* 28.08.2002
International Patent Classification (IPC) or both national classification and IPC H01M8/02		
Applicant NUVERA FUEL CELLS EUROPE S.R.L. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
29.03.2004	05.10.2004
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Koessler, J-L Telephone No. +49 89 2399-7217

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP 03/09554

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1-13 as originally filed

Claims, Numbers

1-24 received on 23.08.2004 with letter of 23.08.2004

Drawings, Sheets

1/7-7/7 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   - ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
   - ☐ the language of publication of the international application (under Rule 48.3(b)).
   - ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   - ☐ contained in the international application in written form.
   - ☐ filed together with the international application in computer readable form.
   - ☐ furnished subsequently to this Authority in written form.
   - ☐ furnished subsequently to this Authority in computer readable form.
   - ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   - ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   - ☐ the description, pages:
   - ☐ the claims, Nos.:
   - ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-24
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-24
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-24
	No:	Claims	

2. Citations and explanations

   see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Cited documents

Reference is made to the following documents:

D1: FR-A-2 810 795 (TECHNICATOME SOC TECH POUR L E) 28 December 2001 (2001-12-28)
D2: EP-A-1 284 512 (ASIA PACIFIC FUEL CELL TECHNOL) 19 February 2003 (2003-02-19)
D3: WO 02 093669 A (BARNETT CHRISTOPHER JAMES ;GASCOYNE JOHN MALCOLM (GB); HARDS GRAHA) 21 November 2002 (2002-11-21)
D4: US-A-5 858 567 (MUEGGENBERG H HARRY ET AL) 12 January 1999 (1999-01-12)
D5: US-A-4 678 724 (MCELROY JAMES F) 7 July 1987 (1987-07-07)
D6: US-A-4 737 257 (BOULTON THOMAS) 12 April 1988 (1988-04-12)

Certain published documents (Rule 70.10)

Application No Patent No	Publication date *(day/month/year)*	Filing date *(day/month/year)*	Priority date *(valid claim)* *(day/month/year)*
EP1284512 (D2)	19.02.2003	14.022003	16.08.2001
WO02093669 (D3)	21.11.2002	14.05.2002	17.05.2001

2 Amendments (Art. 34(2)b PCT)

Basis for the amendment of claim 1 can be found in original claims 1, 15, 18 and on p. 5 l. 7, 12, 13, 18, 19, p. 3 l. 5, 6, p. 7 l. 18-22.

Basis for the amendment of claim 4 can be found on p. 5 l. 21.

The amendments are considered allowable under Art. 34(2)b PCT.

3 Novelty (Art. 33(2) PCT)

The present application relates to a membrane electrochemical generator fed with gaseous reactants and comprising a multiplicity of reaction and cooling cells assembled in a filter-press configuration, each of said reaction cells being delimited by bipolar sheets and being provided with metallic reticulated current collectors/distributors and each of said cooling cells being delimited by bipolar sheets and being provided with a reticulated conductive element. The bipolar sheets are formed by a metallic central body integrated in a frame made of polymeric material and containing distributing and collecting channels.

D1 relates to a bipolar plate for a fuel cell which comprises two metallic plates describes a cooling channel delimited by bipolar sheets. The metallic plates extend over the whole area of the frame. D1 fails to describe that the reaction cells are provided with a reticulated conductive element.

D4 relates to a bipolar plate obtained by soldering of platelets provided with various types of serpentines. The assembling of stacks of those type of bipolar plates foresees the use of separate sealing windows.

D5 describes a fuel cell wherein the bipolar element consists of two shells comprising a hollow internal space for circulating a coolant. In this space, a coolant flow-field insert is housed consisting of a titanium sheet.

D6 relates to a bipolar electrode provided with a frame and openings capable of forming manifolds when overlaid in a filter-press configuration.

None of the cited documents describe bipolar sheets which are formed by a metallic central body having dimensions exceeding those of the active area of the reaction cells and being integrated in a frame made of polymeric material.

The present application meets the requirements of Article 33(2) PCT, because the subject-matter of new claims 1-24 is new.

4 Inventive step (Art. 33(3) PCT)

The closest prior art is considered to be document D1.

The problem underlying the present application is to be regarded as to provide an

alternative bipolar separator for an electrochemical generator having reduced weight, fragility and complexity.

None of the cited documents taken alone or in combination would fairly suggest the solution (i.e. the use of a metallic reticulated element in combination with a metallic central body delimiting the reaction cells) provided in claim 1.

The present application meets the requirements of Art. 33(3) PCT because the subject-matter of claims 1-24 is considered to involve an inventive step.

5 Industrial applicability (Art. 33(4) PCT)

The subject-matter of new claims 1-24 is considered to be industrially applicable.

6 Clarity (art. 6 PCT)

The term "slightly" used in claim 1 is vague and unclear and leaves the reader in doubt as to the meaning of the technical feature to which it refers, thereby rendering the definition of the subject-matter of said claim unclear, Article 6 PCT.

7 Other defects of the application

Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1 is not mentioned in the description, nor is this document identified therein.

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

Patentanwälte
Reitstötter, Kinzebach & Part.
Eing. - 2. Juni 2004 PCT
Sternwartstr. 4 D-81679 München

To:

Reitstötter, Kinzebach
& Partner (GbR)
Postfach 86 06 49
D-81633 München
ALLEMAGNE

WRITTEN OPINION
(PCT Rule 66)

Date of mailing *(day/month/year)*	28.05.2004
Applicant's or agent's file reference M/44244-PCT	**REPLY DUE** **within 3 month(s)** from the above date of mailing

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP 03/09554	28.08.2003	28.08.2002

International Patent Classification (IPC) or both national classification and IPC
H01M8/02

Applicant
NUVERA FUEL CELLS EUROPE S.R.L. et al.

1. This written opinion is the **first** drawn up by this International Preliminary Examining Authority.

2. This opinion contains indications relating to the following items:

I	☒	Basis of the opinion
II	☐	Priority
III	☐	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
IV	☐	Lack of unity of invention
V	☒	Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
VI	☐	Certain documents cited
VII	☐	Certain defects in the international application
VIII	☐	Certain observations on the international application

3. The applicant is hereby **invited to reply** to this opinion.

When? See the time limit indicated above. The applicant may, before the expiration of that time limit, request this Authority to grant an extension, see Rule 66.2(d).

How? By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3. For the form and the language of the amendments, see Rules 66.8 and 66.9.

Also: For an additional opportunity to submit amendments, see Rule 66.4.
For the examiner's obligation to consider amendments and/or arguments, see Rule 66.4 bis.
For an informal communication with the examiner, see Rule 66.6.

If no reply is filed, the international preliminary examination report will be established on the basis of this opinion.

4. The final date by which the international preliminary examination report must be established according to Rule 69.2 is: 28.12.2004

Name and mailing address of the international preliminary examining authority:

European Patent Office
D-80298 Munich
Tel. +49 89 2399 - 0 Tx: 523656 epmu d
Fax: +49 89 2399 - 4465

Authorized Officer
Koessler, J-L

Formalities officer (incl. extension of time limits)
Marchetto, L
Telephone No. +49 89 2399-2796

27.8.04

WRITTEN OPINION

International application No. PCT/EP 03/09554

I. Basis of the opinion

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed")*:

Description, Pages

1-13 as originally filed

Claims, Numbers

1-28 as originally filed

Drawings, Sheets

1/7-7/7 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   - ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
   - ☐ the language of publication of the international application (under Rule 48.3(b)).
   - ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   - ☐ contained in the international application in written form.
   - ☐ filed together with the international application in computer readable form.
   - ☐ furnished subsequently to this Authority in written form.
   - ☐ furnished subsequently to this Authority in computer readable form.
   - ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   - ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   - ☐ the description, pages:
   - ☐ the claims, Nos.:
   - ☐ the drawings, sheets:

5. ☐ This opinion has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

6. Additional observations, if necessary:

V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-4, 7, 8, 10-12, 15-17, 19, 20, 23, 24, 26, 28 (No); 5, 6, 9, 13, 14, 18, 21, 22, 25, 27 (Yes)
Inventive step (IS)	Claims	1-28 (No)
Industrial applicability (IA)	Claims	1-28 (Yes)

2. Citations and explanations

see separate sheet

Re Item V

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Cited documents

Reference is made to the following documents:

D1: FR-A-2 810 795 (TECHNICATOME SOC TECH POUR L E) 28 December 2001 (2001-12-28)

D2: EP-A-1 284 512 (ASIA PACIFIC FUEL CELL TECHNOL) 19 February 2003 (2003-02-19)

D3: WO 02 093669 A (BARNETT CHRISTOPHER JAMES ;GASCOYNE JOHN MALCOLM (GB); HARDS GRAHA) 21 November 2002 (2002-11-21)

D4: US-A-5 858 567 (MUEGGENBERG H HARRY ET AL) 12 January 1999 (1999-01-12)

D5: US-A-4 678 724 (MCELROY JAMES F) 7 July 1987 (1987-07-07)

D6: US-A-4 737 257 (BOULTON THOMAS) 12 April 1988 (1988-04-12)

Certain published documents (Rule 70.10)

Application No Patent No	Publication date *(day/month/year)*	Filing date *(day/month/year)*	Priority date *(valid claim)* *(day/month/year)*
EP1284512 (D2)	19.02.2003	14.022003	16.08.2001
WO02093669 (D3)	21.11.2002	14.05.2002	17.05.2001

2 Novelty (Art. 33(2) PCT)

The present application relates to a membrane electrochemical generator fed with gaseous reactants and comprising a multiplicity of reaction cells assembled in a filter-press configuration, each of said reaction cells being delimited by bipolar sheets, characterised in that said bipolar sheets are formed by a metallic central body integrated in a frame made of polymeric material and containing distributing and collecting channels.

D1 relates to a bipolar plate for a fuel cell which comprises two metallic plates separated by segments and having recesses for the production of a composite conducting body in a single molding operation. This document is novelty destroying for claims 1 (claim 1 of D1), 2 (claim 1 of D1), 4 (claim 2 of D1), 7 (claim 5 of D1), 8 (claim 5 of D1), 10 (fig. 1 of D1), 11 (fig. 1 of D1), 12 (claim 9 of D1), 15 (fig. 4), 16 (claim 1, p. 8 l. 12-17 of D1), 17 (p. 8 l. 12-17of D1), 19 (fig. 4 of D1), 20 (fig. 4 of D1), 23 (fig. 4 of D1), 24 (fig. 4 of D1), 28.

D4 relates to fuel cells employing integrated fluid management platelet technology. This documents anticipates claims 1 (fig. 5-10, column 6 l. 10-20 of D4), 10 (fig. 5 of D4), 11 (fig. 5 of D4), 15 (fig. 5-10 of D4), 16 (fig. 5-10 of D4), 17 (column 5 l. 6-9 of D4), 19 (fig. 5-10 of D4), 20 (fig. 5-10 of D4), 23 (fig. 5-10 of D4), 24 (fig. 5-10 of D4), 26 (fig. 5-10 of D4), 28.

D5 relates to fuel cell battery with improved membrane cooling. This document is novelty destroying for claims 1 (fig. 1 of D5), 2 (column 5l. 24-26 of D5), 10 (fig. 1 of D5), 11 (fig. 1 of D5), 12 (column 5 l. 40-42 of D5), 15 (fig. 1, 2 of D5), 16 (fig. 1, 2 of D5), 19 (fig. 2 of D5), 20 (fig. 1 of D5), 23 (fig. 2 of D5), 24 (fig. 1, 2 of D5), 26 (fig. 1 of D5), 28.

D6 relates to an electrode for electrochemical cell. This document anticipates claims 1 (fig. 1 of D6), 2 (column 10 l. 51-54 and column 5 l. 57-59 of D6), 3 (column 10 l. 51-54 and column 5 l. 57-59 of D6), 4 (column 12 l. 12-15 of D6), 10 (fig. 1 of D6), 11 (fig. 1 of D6), 12 (column 10 l. 55 to column 11 l. 8 of D6), 15 (fig.1 of D6), 16 (fig. 1 of D6), 17 (fig. 1, column 12 l. 66, 67 of D6), 19 (fig. 1 of D6), 20 (fig. 1 of D6), 23 (fig. 1 of D6), 24 (fig. 1 of D6), 26 (fig. 1 of D6), 28.

The present application does not meet the requirements of Article 33(2) PCT, because the subject-matter of claims 1-4, 7, 8, 10-12, 15-17, 19, 20, 23, 24, 26, 28 is not new.

3 Inventive step (Art. 33(3) PCT)

The closest prior art is considered to be document D1.

The problem underlying the present application is to be regarded as to provide an alternative bipolar separator for an electrochemical generator.

If the Applicant is able to meet the above novelty objections he/she is requested to demonstrate where the inventive step of the remaining subject-matter is to be found with respect to the nearest prior art document.

4 Industrial applicability (Art. 33(4) PCT)

The subject-matter of claims 1-28 is considered to be industrially applicable.

5 Clarity (art. 6 PCT)

The claims shall not rely on such references as "as illustrated in figure ... of the drawings" (Rule 6.2 (a) PCT). Therefore present claim 28 does not meet the requirements of Art. 6 PCT.

6 Other defects of the application

Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1, D4-D5 is not mentioned in the description, nor are these documents identified therein.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference M/44244-PCT	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/EP 03/09554	International filing date *(day/month/year)* 28.08.2003	Priority date *(day/month/year)* 28.08.2002
International Patent Classification (IPC) or both national classification and IPC H01M8/02		
Applicant NUVERA FUEL CELLS EUROPE S.R.L. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
29.03.2004	05.10.2004
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Koessler, J-L Telephone No. +49 89 2399-7217

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP 03/09554

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1-13 as originally filed

Claims, Numbers

1-24 received on 23.08.2004 with letter of 23.08.2004

Drawings, Sheets

1/7-7/7 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-24
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-24
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-24
	No:	Claims	

2. Citations and explanations

   see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Cited documents

Reference is made to the following documents:

D1: FR-A-2 810 795 (TECHNICATOME SOC TECH POUR L E) 28 December 2001 (2001-12-28)
D2: EP-A-1 284 512 (ASIA PACIFIC FUEL CELL TECHNOL) 19 February 2003 (2003-02-19)
D3: WO 02 093669 A (BARNETT CHRISTOPHER JAMES ;GASCOYNE JOHN MALCOLM (GB); HARDS GRAHA) 21 November 2002 (2002-11-21)
D4: US-A-5 858 567 (MUEGGENBERG H HARRY ET AL) 12 January 1999 (1999-01-12)
D5: US-A-4 678 724 (MCELROY JAMES F) 7 July 1987 (1987-07-07)
D6: US-A-4 737 257 (BOULTON THOMAS) 12 April 1988 (1988-04-12)

Certain published documents (Rule 70.10)

Application No Patent No	Publication date *(day/month/year)*	Filing date *(day/month/year)*	Priority date *(valid claim)* *(day/month/year)*
EP1284512 (D2)	19.02.2003	14.022003	16.08.2001
WO02093669 (D3)	21.11.2002	14.05.2002	17.05.2001

2 Amendments (Art. 34(2)b PCT)

Basis for the amendment of claim 1 can be found in original claims 1, 15, 18 and on p. 5 l. 7, 12, 13, 18, 19, p. 3 l. 5, 6, p. 7 l. 18-22.

Basis for the amendment of claim 4 can be found on p. 5 l. 21.

The amendments are considered allowable under Art. 34(2)b PCT.

3 Novelty (Art. 33(2) PCT)

The present application relates to a membrane electrochemical generator fed with gaseous reactants and comprising a multiplicity of reaction and cooling cells assembled in a filter-press configuration, each of said reaction cells being delimited by bipolar sheets and being provided with metallic reticulated current collectors/distributors and each of said cooling cells being delimited by bipolar sheets and being provided with a reticulated conductive element. The bipolar sheets are formed by a metallic central body integrated in a frame made of polymeric material and containing distributing and collecting channels.

D1 relates to a bipolar plate for a fuel cell which comprises two metallic plates describes a cooling channel delimited by bipolar sheets. The metallic plates extend over the whole area of the frame. D1 fails to describe that the reaction cells are provided with a reticulated conductive element.

D4 relates to a bipolar plate obtained by soldering of platelets provided with various types of serpentines. The assembling of stacks of those type of bipolar plates foresees the use of separate sealing windows.

D5 describes a fuel cell wherein the bipolar element consists of two shells comprising a hollow internal space for circulating a coolant. In this space, a coolant flow-field insert is housed consisting of a titanium sheet.

D6 relates to a bipolar electrode provided with a frame and openings capable of forming manifolds when overlaid in a filter-press configuration.

None of the cited documents describe bipolar sheets which are formed by a metallic central body having dimensions exceeding those of the active area of the reaction cells and being integrated in a frame made of polymeric material.

The present application meets the requirements of Article 33(2) PCT, because the subject-matter of new claims 1-24 is new.

4 Inventive step (Art. 33(3) PCT)

The closest prior art is considered to be document D1.

The problem underlying the present application is to be regarded as to provide an

alternative bipolar separator for an electrochemical generator having reduced weight, fragility and complexity.

None of the cited documents taken alone or in combination would fairly suggest the solution (i.e. the use of a metallic reticulated element in combination with a metallic central body delimiting the reaction cells) provided in claim 1.

The present application meets the requirements of Art. 33(3) PCT because the subject-matter of claims 1-24 is considered to involve an inventive step.

5 Industrial applicability (Art. 33(4) PCT)

The subject-matter of new claims 1-24 is considered to be industrially applicable.

6 Clarity (art. 6 PCT)

The term "slightly" used in claim 1 is vague and unclear and leaves the reader in doubt as to the meaning of the technical feature to which it refers, thereby rendering the definition of the subject-matter of said claim unclear, Article 6 PCT.

7 Other defects of the application

Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1 is not mentioned in the description, nor is this document identified therein.

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* M/44244-PCT

Box No. I TITLE OF INVENTION

Membrane electrochemical generator

Box No. II APPLICANT ☐ This person is also inventor.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

NUVERA FUEL CELLS EUROPE S.r.l.
Via Bistolfi, 35
I-20134 Milano
Italy

Telephone No.

Facsimile No.

Teleprinter No.

Applicant's registration No. with the Office

State *(that is, country)* of nationality: IT

State *(that is, country)* of residence: IT

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

TRIFONI, Eduardo
Via Donizetti 5
80127 Napoli
Italy

This person is:
☐ applicant only
☒ applicant and inventor
☐ inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality: IT

State *(that is, country)* of residence: IT

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

Reitstötter, Kinzebach & Partner (GbR)
Patentanwälte
Kinzebach, Werner; Riedl, Peter; Schweiger, Georg; Müller, J. Uwe;
Wolter, Thomas; Thalhammer, Wolfgang; Rabe, Andreas
Sternwartstraße 4
D - 81679 München

Telephone No.
089-99 83 970

Facsimile No.
089-98 73 04

Teleprinter No.

Agent's registration No. with the Office

☐ **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Continuation of Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

If none of the following sub-boxes is used, this sheet should not be included in the request.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

LIOTTA, Marcello
Via della Cooperazione 117
20089 Rozzano (MI)
Italy

This person is:
- [ ] applicant only
- [X] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality: IT

State *(that is, country)* of residence: IT

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [X] the United States of America only
- [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [ ] the United States of America only
- [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [ ] the United States of America only
- [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [ ] the United States of America only
- [ ] the States indicated in the Supplemental Box

- [ ] Further applicants and/or (further) inventors are indicated on another continuation sheet.

Box No. V DESIGNATION OF STATES *Mark the applicable check-boxes below; at least one must be marked.*

The following designations are hereby made under Rule 4.9(a):

Regional Patent

☒ **AP** **ARIPO Patent:** **GH** Ghana, **GM** Gambia, **KE** Kenya, **LS** Lesotho, **MW** Malawi, **MZ** Mozambique, **SD** Sudan, **SL** Sierra Leone, **SZ** Swaziland, **TZ** United Republic of Tanzania, **UG** Uganda, **ZM** Zambia, **ZW** Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

☒ **EA** **Eurasian Patent:** **AM** Armenia, **AZ** Azerbaijan, **BY** Belarus, **KG** Kyrgyzstan, **KZ** Kazakhstan, **MD** Republic of Moldova, **RU** Russian Federation, **TJ** Tajikistan, **TM** Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT

☒ **EP** **European Patent:** **AT** Austria, **BE** Belgium, **CH & LI** Switzerland and Liechtenstein, **CY** Cyprus, **DE** Germany, **DK** Denmark, **ES** Spain, **FI** Finland, **FR** France, **GB** United Kingdom, **GR** Greece, **IE** Ireland, **IT** Italy, **LU** Luxembourg, **MC** Monaco, **NL** Netherlands, **PT** Portugal, **SE** Sweden, **TR** Turkey, and any other State which is a Contracting State of the European Patent Convention and of the PCT

☒ **OA** **OAPI Patent:** **BF** Burkina Faso, **BJ** Benin, **CF** Central African Republic, **CG** Congo, **CI** Côte d'Ivoire, **CM** Cameroon, **GA** Gabon, **GN** Guinea, **GQ** Equatorial Guinea, **GW** Guinea-Bissau, **ML** Mali, **MR** Mauritania, **NE** Niger, **SN** Senegal, **TD** Chad, **TG** Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

☒ **AE** United Arab Emirates
☒ **AG** Antigua and Barbuda
☒ **AL** Albania .....
☒ **AM** Armenia .....
☒ **AT** Austria .....
☒ **AU** Australia .....
☒ **AZ** Azerbaijan .....
☒ **BA** Bosnia and Herzegovina .....
☒ **BB** Barbados
☒ **BG** Bulgaria .....
☒ **BR** Brazil .....
☒ **BY** Belarus .....
☒ **BZ** Belize .....
☒ **CA** Canada
☒ **CH & LI** Switzerland and Liechtenstein
☒ **CN** China .....
☒ **CO** Colombia .....
☒ **CR** Costa Rica .....
☒ **CU** Cuba .....
☒ **CZ** Czech Republic .....
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☒ **IL** Israel .....
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☒ **IS** Iceland
☒ **JP** Japan .....
☒ **KE** Kenya .....
☒ **KG** Kyrgyzstan .....
☒ **KP** Democratic People's Republic of Korea .....
☒ **KR** Republic of Korea .....
☒ **KZ** Kazakhstan .....
☒ **LC** Saint Lucia
☒ **LK** Sri Lanka
☒ **LR** Liberia
☒ **LS** Lesotho .....
☒ **LT** Lithuania
☒ **LU** Luxembourg
☒ **LV** Latvia
☒ **MA** Marocco .....
☒ **MD** Republic of Moldova .....
☒ **MG** Madagascar .....
☒ **MK** The former Yugoslav Republic of Macedonia .....
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☒ ..... ☐ ..... ☐ .....
☐ ..... ☐ ..... ☐ .....

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)*

Box No. VI PRIORITY CLAIM

The priority of the following earlier application(s) is hereby claimed:

Filing date of earlier application *(day/month/year)*	Number of earlier application	Where earlier application is:		
		national application: country	regional application:* regional Office	international application: receiving Office
Item (1) 28. August 2002 28.08.2002	MI2002A001859	Italy		
Item (2)				
Item (3)				
Item (4)				
item (5)				

☐ Further priority claims are indicated in the Supplemental Box.

The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of this international application is the receiving Office)* identified above as:

☐ all items ☐ item (1) ☐ item (2) ☐ item (3) ☐ item (4) ☐ item (5) ☐ other, see Supplemental Box

* *Where the earlier application is an ARIPO application, indicate at least one country party to the Paris Convention for the Protection of Industrial Property or one Member of the World Trade Organization for which that earlier application was filed (Rule 4.10(b)(ii)):* .....

.....

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):*

ISA / .....

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority):*

Date *(day/month/year)* Number Country *(or regional Office)*

Box No. VIII DECLARATIONS

The following **declarations** are contained in Boxes Nos. VIII (i) to (v) *(mark the applicable check-boxes below and indicate in the right column the number of each type of declaration):* Number of declarations

☐ Box No. VIII (i)	Declaration as to the identity of the inventor	:
☐ Box No. VIII (ii)	Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent	:
☐ Box No. VIII (iii)	Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application	:
☐ Box No. VIII (iv)	Declaration of inventorship (only for the purposes of the designation of the United States of America)	:
☐ Box No. VIII (v)	Declaration as to non-prejudicial disclosures or exceptions to lack of novelty	:

Box No. IX CHECK LIST; LANGUAGE OF FILING

This international application **contains**:

(a) the following number of **sheets in paper form**:

request (including declaration sheets)	:	5
description (excluding sequence listing part)	:	13
claims	:	4
abstract	:	1
drawings	:	7
Sub-total number of sheets	:	30
sequence listing part of description *(actual number of sheets if filed in paper form, whether or not also filed in computer readable form; see (b) below)*	:	
Total number of sheets	:	30

(b) sequence listing part of description filed in **computer readable form**

(i) ☐ only (under Section 801(a)(i))

(ii) ☐ in addition to being filed in paper form (under Section 801(a)(ii))

Type and number of carriers (diskette, CD-ROM, CD-R or other) on which the sequence listing part is contained *(additional copies to be indicated under item 9(ii), in right column)*: .....

This international application is **accompanied by** the following item(s) *(mark the applicable check-boxes below and indicate in right column the number of each item)*:

		Number of items
1. ☒	fee calculation sheet	: 1
2. ☒	original separate power of attorney	: 2
3. ☐	original general power of attorney	:
4. ☐	copy of general power of attorney; reference number, if any:	:
5. ☐	statement explaining lack of signature	:
6. ☐	priority document(s) identified in Box No. VI as item(s): 1	: 1
7. ☐	translation of international application into *(language)*:	:
8. ☐	separate indications concerning deposited microorganism or other biological material	:
9. ☐	sequence listing in computer readable form (indicate also type and number of carriers (diskette, CD-ROM, CD-R or other))	
	(i) ☐ copy submitted for the purposes of international search under Rule 13*ter* only (and not as part of the international application)	:
	(ii) ☐ *(only where check-box (b)(i) or (b)(ii) is marked in left column)* additional copies including, where applicable, the copy for the purposes of international search under Rule 13*ter*	:
	(iii) ☐ together with relevant statement as to the identity of the copy or copies with the sequence listing part mentioned in left column	:
10. ☐	other *(specify)*:	:

Figure of the drawings which should accompany the abstract: 3

Language of filing of the international application: englisch

Box No. X SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

Munich, August 28, 2003 J. Uwe Müller hs

For receiving Office use only

1. Date of actual receipt of the purported international application:

2. Drawings:
☐ received:
☐ not received:

3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:

4. Date of timely receipt of the required corrections under PCT Article 11(2):

5. International Searching Authority (if two or more are competent): ISA /

6. ☐ Transmittal of search copy delayed until search fee is paid.

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

Vollmacht[1] Authorisation[1] Pouvoir[1]

Bitte vor dem Ausfüllen des Formblatts Rückseite beachten. / Please read the notes overleaf before completing the form. / Veuillez lire les remarques au verso avant de remplir le formulaire

Zeichen des Vertreters (der Vertreter) / Representative's reference / Référence du (des) mandataire(s) (max. 15 Positionen / max. 15 spaces / 15 caractères au maximum)

Nr. der Anmeldung (des Patents) / Application/Patent No. / N° de la demande (du brevet)

Ich (Wir) / I (We) / Je (Nous)[2]

1. **Eduardo Trifoni** - Via Donizetti 5 - 80127 Napoli, Italy
2. **Marcello Liotta** - Via della Cooperazione 117 –20089 Rozzano (MI), Italy

Bevollmächtige(n) hiermit / do hereby authorise / autorise (autorisons) par la présente[3]

Reitstötter, Kinzebach & Partner
Dr. Werner Kinzebach • Dr. Peter Riedl • Dr. Georg Schweiger • Dr. J. Uwe Müller
Postfach 86 06 49
D-81633 München / Germany (DE)

☐ Weitere Vertreter sind auf einem gesonderten Blatt angegeben. / Additional representatives indicated on supplementary sheet. / D'autres mandataires sont mentionnés sur une feuille supplémentaire.

mich (uns) zu vertreten als / to represent me (us) as / à me (nous) représenter en tant que

☒ Anmelder oder Patentinhaber, / applicant(s) or patent proprietor(s), / demandeur(s) ou titulaire(s) du brevet,

☐ Einsprechenden (Einsprechende), / opponent(s), / opposant(s),

für mich (uns) zu handeln in den durch das Europäische Patentübereinkommen geschaffenen Verfahren in der-(den) folgenden europäischen Patentanmeldung(en) oder dem (den) folgenden europäischen Patent(en)[4] und Zahlungen für mich (uns) in Empfang zu nehmen: / to act for me (us) in all proceedings established by the European Patent Convention concerning the following European patent application(s) or patent(s)[4] and to receive payments on my (our) behalf: / à agir en mon (notre) nom dans toute procédure instituée par la Convention sur le brevet européen et concernant la (les) demande(s) de brevet ou le (les) brevet(s) européen(s)[4] suivant(s) et à recevoir des paiements en mon (notre) nom:

MEMBRANE ELECTROCHEMICAL GENERATOR

☐ Weitere Anmeldungen oder Patente sind auf einem gesonderten Blatt angegeben. / Additional applications or patents indicated on supplementary sheet. / D'autres demandes ou brevets sont mentionnés sur une feuille supplémentaire.

☒ Die Vollmacht gilt auch für Verfahren nach dem Vertrag über die internationale Zusammenarbeit auf dem Gebiet des Patentwesens. / This authorisation shall also apply to the same extent to any proceedings established by the Patent Cooperation Treaty. / Ce pouvoir s'applique également à toute procédure instituée par le Traité de coopération en matière de brevets.

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☒ Untervollmacht kann erteilt werden. / Sub-authorisation may be given. / Le pouvoir pourra être délégué.

☐ Ich (Wir) widerrufe(n) hiermit frühere Vollmachten in Sachen der obenbezeichneten Anmeldung(en) oder des obenbezeichneten Patents (der obenbezeichneten Patente)[5]. / I (We) hereby revoke all previous authorisations in respect of the above application(s) or patent(s)[5] / Je révoque (Nous révoquons) par la présente tout pouvoir antérieur, donné pour la (les) demande(s) ou le (les) brevet(s) mentionné(s) ci-dessus[5].

Ort/Place/Lieu : Milan

Datum/Date : July 14, 2003

Unterschrift(en) / Signature(s)[6]

Eduardo Trifoni

Marcello Liotta

Das Formblatt muß vom (von den) Vollmachtgeber(n) (bei juristischen Personen vom Unterschriftsberechtigten) eigenhändig unterzeichnet sein. Nach der Unterschrift bitte den (die) Namen des (der) Unterzeichneten in Druckschrift wiederholen (bei juristischen Personen die Stellung des Unterschriftsberechtigten innerhalb der Gesellschaft angeben). / The form must bear the personal signature(s) of the authorisor(s) (in the case of legal persons, that of the officer empowered to sign). After the signature, please print the name(s) of the signatory(ies) adding, in the case of legal persons, his (their) position within the company. / Le formulaire doit être signé de la propre main du (des) mandant(s) (dans le cas de personnes morales, de la personne ayant qualité pour signer). Veuillez ajouter en caractères d'imprimerie, après la signature, le (les) nom(s) du (des) signataire(s) en mentionnant, dans le cas de personnes morales, son (leurs) fonctions au sein de la société.